CLEAN ROOMS

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Compiled by
Tena Crenshaw
and Mary Kihm

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Periodicals

1. AACC TACKLES SPECIAL PROBLEMS IN CONTROLLING CONTAMINATION. Heating, Piping and Air Conditioning, July 1964, 36: 121.

   Short summaries are presented of papers given at the third annual technical meeting of the American Association for Contamination Control concerning laminar flow clean rooms and work stations. The discussions ranged from "hardware" cleaning to microbiological contamination.

2. CLEAN ROOM COMMUNICATOR. The Journal of the American Association for Contamination Control, September 1965, 4: 21.

   At TRW/Space Technology Laboratories the costly problem of communicating with clean room personnel was solved by installing a "Talk-Thru" window.

3. CLEAN ROOMS FOR ENVIRONMENTAL CONTROL. Westinghouse Engineer, January 1963, 23: 32.

   Westinghouse Corporation's experience in the clean room field has been consolidated, and engineers are performing a coordinated service for anyone who needs a clean room. Engineers perform studies of individual requirements, design the rooms, make recommendations for all equipment, and complete installation of the structure.

4. CLEAN ROOMS NEED AIR THAT'S CLEANED AND PRESSED. Mill and Factory, February 1965, 76: 72.

   At the Electronic Specialty Company plant, where delicate instruments and components for precision gyros are manufactured, a better way was found for controlling instrument air.

5. Harris, George J., Towson, Paul H., and Gremillion, Gardner G. TEST NEW ELECTRIC INCINERATOR DESIGN FOR STERILIZING LABORATORY AIR. Heating, Piping and Air Conditioning, February 1964, 36: 94-95.

   Air streams carrying infectious aerosols can be sterilized with the electric incinerator described. This new design is compact and provides ready access to heaters for maintenance. The results of performance tests on two sterilizers capable of handling 16 and 100 cfm are given.

6. Hume, William A. FACTORS IN VERIFICATION OF CLEANLINESS. Research/Development, July 1965, 16: 22-26.

   Two of the clean rooms of an aircraft corporation laboratory are described. Air circulation, temperature and humdidity are rigidly controlled in these rooms, and all personnel wear special clothing according to the degree of cleanliness required.

7. IN SEARCH OF A CLEAN ROOM. Heating, Piping and Air Conditioning. January 1963, 35: 187-202.

Clean rooms have come about as a result of trying to control fine particle contamination. These "white rooms" are indispensable in this age of missile and miniaturization because of the enormous number of fine particles existing in the atmosphere, and the extremely small mating clearances and other physical limitations imposed upon a wide range of missile-age products. The pitfalls in designing clean rooms are carefully considered in this paper.

8. Kutnewsky, Fremont. LAMINAR AIR FLOW. Compressed Air, January 1965, 70: 13.

Laminar air flow means uniform movement of ultraclean air through a room or work station that literally "washes away" dust particles originating within the room from equipment of personnel. This principle was developed by a physicist employed by Sandia Corporation in New Mexico.

9. Kutnewsky, Fremont. LAMINAR DOWNFLOW SWEEPS BACTERIA FROM CLEAN ROOM, SANDIA EXPERIMENT HINTS. The Journal of the American Association for Contamination Control, August 1965, 4: 8-11.

After six months of studies at Sandia Laboratory, it was found that eliminating 0.5 microns and larger airborne particulate contamination also eliminated airborne microbiological contamination -- bacteria and fungi.

10. LAMINAR FLOW: STRONGER THAN DIRT. The Iron Age, February 1965, 195: 71.

Clean rooms have become increasingly important in the manufacture of precision components. A new laminar flow room was built to permit manufacture of parts cleaner than ever before.

11. Lindeken, C. L. SELECTION, INSTALLATION AND MAINTENANCE OF WHITE ROOM FILTERS. Air Engineering, February 1963, 5: 20-51.

The engineer will find information here on the criteria for evaluating, testing, and selecting filters for any white room air filtration requirements, along with tips on installation, uncrating, maintenance and capacity loadings.

12. Little, James C. FILTERS FOR CLEAN ROOM SERVICE. Heating, Piping and Air Conditioning, September 1965, 37: 142-146.

Particle concentrations in six clean rooms with different equipment configurations have been given with test data and the author's suggestions for filter selection and installation.

13. Little, James C. MULTITESTING OF LAMINAR FLOW CLEAN ROOMS. Heating, Piping and Air Conditioning, October 1965, 37: 133-136.

A clean room can be tested in many ways before being put into service. The various tests employed in clean rooms at Oak Ridge are summarized.

14. Magill, Paul L. AN AUTOMATED WAY TO COUNT FINE PARTICLES. Air Engineering, October 1962, 2: 31-34.

Detailed data has been included by Mr. Magill on the operation, application and potential of automatic particle counters, and design criteria given on monochromatic light scattering methods relating to development of the automatic counter.

15. Olbur, Hugh M. SPACE AGE CHALLENGE: NEARLY CONSTANT ROOM TEMPERATURES. Heating, Piping and Air Conditioning, May 1964, 36: 137-141.

Precise measurement of space age components is being achieved in the Boeing Company's metrology laboratory with an air conditioning system that controls air temperature within plus or minus 0.1 of a degree.

16. Rice, Richard S. HOW THE SMALL BUSINESS CAN ACQUIRE CLEAN WORK SPACE. The Journal of the American Association for Contamination Control, September 1965, 4: 9-23.

The small business man faces many problems of contamination control in manufacturing. Such items as special costs, tax factors, and types of clean rooms are discussed.

17. Smith, O. F. Jr. ENVIRONMENTAL CONTROL FOR MANUFACTURING AREAS--WHAT KIND AND HOW MUCH? Heating, Piping and Air Conditioning, November 1964, 36: 99-102.

The design of a clean room is a challenge to match environmental control to process requirements for maximum mutual economy, not an opportunity to erect a monument to engineering know-how.

18. Smith, O. F. Jr. HOW TO APPLY ENVIRONMENTAL CONTROL FOR MANUFACTURING AREAS. Heating, Piping and Air Conditioning, December 1964, 36: 119-125.

Four case studies illustrate how environmental control problems encountered in manufacturing areas can be solved with maximum economy by applying sound engineering considerations. Illustrations of snow white clean rooms are presented.

19. SUPER-CLEAN WHITE ROOM. Research/Development, April 1965, 16: 36-37.

A white room constructed by General Electric Company in Lynn, Massachusetts provides super-clean conditions for the assembly of gyroscopes, accelerometers, and other precision units for aerospace applications.

20. THE CLEAN ROOM GOES MOBILE. Research/Development, July 1963, 14: 14-16.

Matthews Research, Inc. has manufactured a unique work station called a White Bench. In many ways, the bench can actually be considered a mobile clean room in miniature.

21. Wathen, Paul and Lough, Wendell. CLEAN ROOMS DON'T JUST HAPPEN. Plant Engineering, December 1963, 17: 106-109.

Important factors must be considered before a clean room can be designed. These factors are cleanliness, temperature levels, humidity fluctuations, and optimizing lighting levels.

22. Whitfield, Willis J. A NEW APPROACH TO CLEAN ROOM DESIGN. Proceedings of the Institute of Environmental Sciences, 1962: 529-534.

Mr. Whitfield explains in this article how Sandia Corporation - Advanced Manufacturing Development Division - pinpointed three major problems in trying to improve clean rooms.

Documents and Papers

1. Air Force. STANDARDS AND GUIDELINES FOR THE DESIGN AND OPERATION OF CLEAN ROOMS AND CLEAN WORK STATIONS, August 31, 1965, 57p. T.O. 00-25-203.

This Technical Order lists guidelines for achieving environmental control operating standards to be used by Air Force activities as a minimum criteria for the overhaul of items requiring environmental control.

2. Air Force Logistics Command. Olmsted AFB, Pennsylvania. Industrial Engineering Division. LAMINAR AIR-FLOW CONCEPT FOR CLEAN ROOM CONSTRUCTION, July 31, 1963, 15p.

Facts concerning the laminar flow principle are presented in this study. Such principles as laminar flow as applied to clean room design, and the adaptability of laminar flow rooms to production work are explained.

3. American Association for Contamination Control. AUSTIN CONTAMINATION INDEX, by Philip R. Austin. Fourth Annual Technical Meeting and Exhibit, May 1965, 4p.

In designing a clean room, the contamination load must be predicted. This Index allows contamination loads for clean rooms to be predicted.

4. American Association for Contamination Control. CLEAN ROOM DESIGN CRITERIA AND THEIR RELATION TO COST, by Richard S. Rice. Second Annual Convention, April-May 1963, 10 p. AACC Pub. 63-19.

Analysis is made of the effect of design criteria decisions on the construction costs for facilities concerned with aerospace technology.

5. American Association for Contamination Control. VERIFICATION OF AEROSPACE FACILITIES LEVELS TO MEET MILITARY SPECIFICATIONS, by Kenneth Halliday. Fourth Annual Technical Meeting and Exhibit, May 1965, 10p.

Steps that have to be taken before a clean room can be qualified to meet military specifications are outlined.

6. American Association for Contamination Control. EXTENDED PARAMETERS FOR CLEAN ROOM DESIGN AND CONSTRUCTION, by J. J. Mooney. Second Annual Convention, April-May 1963, 3p. AACC Pub. 63-2

This paper deals with additional parameters vital to the resultant design and feasibility of employing clean rooms in the manufacture and development of products.

7. American Association for Contamination Control. HOW CLEAN IS THE ROOM?, by J. Mason Pilcher. Second Annual Convention, April-May 1963, 20p. AACC Pub. 63-4.

The problem of air-borne contaminant monitoring in clean rooms is discussed by Dr. Pilcher. Recommendations are made for proper air-sampling procedures and clean room monitoring techniques.

8. American Association for Contamination Control. MICROBIOLOGICAL CONTAMINATION IN CLEAN ROOMS AND BIOCLEAN ROOMS, by Karl Koreluk. Fourth Annual Technical Meeting and Exhibit, May 1965, 10p.

Boeing Company has conducted studies during the past year to acquire information on the microbiological contamination levels of clean room facilities within the company. This paper reports on these studies and the results that have been obtained.

9. American Association for Contamination Control. PRINCIPLES OF ULTRACLEANING FLUSH CLEANING SYSTEMS, by Walter W. Kenyon. Second Annual Convention, April-May 1963, 10p. AACC Pub. 63-28.

Flush cleaning, the author has pointed out, is usually the final and most critical operation in assuring cleanliness of fluid handling or fluid containing systems.

10. American Association for Contamination Control. DESIGN AND CONSTRUCTION OF A 20,000 SQUARE FOOT DOWN FLOW CLEAN ROOM, by F. C. Weisbach. Fourth Annual Technical Meeting and Exhibit, May 1965, 11p.

The problems encountered by RCA in designing clean rooms for their 157,000 square foot plant at Lancaster, Pennsylvania have been described. This facility represents one of the most complex engineering and manufacturing buildings within the electronics industry.

11. American Association for Contamination Control. SIGNIFICANT PARAMETERS OF CLEAN ROOM DESIGN, by Ernest E. Choat. Fourth Annual Technical Meeting and Exhibit, May 1965, 11p.

"High-Purity Laboratory", erected at the Atomic Energy Commission's Oak Ridge, Y-12 Plant is described. Design parameters as they apply to vertical laminar flow rooms are discussed. Concept and design, construction, and performance data have been taken into consideration.

12. American Association for Contamination Control. THE DESIGN OF AN R&D CLEAN ROOM COMPLEX FOR GUIDANCE AND CONTROL SYSTEMS, by Will Gibson. Fourth Annual Technical Meeting and Exhibit, May 1965, 10p.

Layout, Equipment, operation and cost of the clean room built by the Army at their Inertial Guidance and Control Laboratory at Huntsville, Alabama are discussed.

13. American Association for Contamination Control. USE OF DUST CONTROLLED HOODS IN WHITE ROOMS, by Marvin A. Pratt. Second Annual Convention, April-May 1963, 6p. AACC Pub. 63-21.

This paper deals mainly with shrouded workplaces, called Sterilshields, where controlled environment is provided for articles from about one cubic foot of volume down to the subminiature. It does recognize that room-size environmental control may be the only pattern for protection of large objects, or large assemblies of smaller components.

14. American Society for Testing and Materials. TENTATIVE METHOD FOR SIZING AND COUNTING AIRBORNE PARTICULATE CONTAMINATION IN CLEAN ROOMS AND OTHER DUST-CONTROLLED AREAS DESIGN FOR ELECTRONIC AND SIMILAR APPLICATIONS. ASTM F-25-63.

The method given in this standard covers a procedure for counting and sizing airborne particulate matter 5 and larger. The sampling areas are specifically those with contamination levels typical of clean rooms (white and gray rooms) and dust-controlled areas designed for electronic work.

15. Army Biological Laboratories, Fort Detrick, Maryland, Physical Defense Division. MICROBIAL CONTAMINATION IN A CLEAN ROOM WHEN OCCUPIED BY OPERATING PERSONNEL, by D. M. Portner, L. M. Buchanan, and Charles L. Mullican, August 1964, 12p. NASA CR-58369 - X64-16097

As part of the overall study of spacecraft sterilization, a brief investigation was undertaken in a clean room to determine microbial contamination resulting from the presence of personnel. The results reported compare the level of microbial contamination by personnel when wearing clean room clothing and masks while sitting, when they were active, and when they were in street clothes and active.

16. Army Biological Laboratories, Fort Detrick, Maryland. Physical Defense Division. MICROBIAL CONTAMINATION IN CLEAN ROOMS, by D. M. Portner, R. K. Hoffman, and Charles R. Phillips, March 1965, 17p. AD 459 387 - X65-15789

A study to determine the level of microbial contamination in an industrial clean room was undertaken as part of the spacecraft sterilization investigations.

17. Army Biological Laboratories, Fort Detrick, Maryland. Physical Defense Division. THE LEVEL OF MICROBIAL CONTAMINATION IN A CLEAN ROOM DURING A ONE YEAR PERIOD, by Dorothy M. Portner, December 1964, 20p. NASA CR-60184 - N65-15148

This study was undertaken in order to find the level of microbial contamination in a clean room so that a basis could be established for deciding whether it is advantageous from a minimal microbial contamination standpoint to assemble a spacecraft in such an area.

18. Army Chemical Corps, Fort Detrick, Maryland. Physical Defense Division. THE LEVEL OF MICROBIAL CONTAMINATION IN A CLEAN ROOM DURING AN ELEVEN WEEK TEST PERIOD, by Dorothy M. Portner, February 1964, 18p. NASA CR-53127 - X64-12719

An investigation was made to determine the level of microbial contamination in a clean room designed to enumerate only the viable aerobic and anaerobic microorganisms present. An essential part of the study was to determine the number of viable aerobes and anaerobes that accumulate on a stainless-steel surface over an extended period.

19. Army Missile Command, Huntsville, Alabama. Inertial Guidance and Control Laboratory. THE ARMY'S NEW INERTIAL GUIDANCE AND CONTROL FACILITY, by Charles Riley, March 1965, 58p. AD 464 175 - N65-26235

The purpose of this report is to identify and describe the special features and equipment provided in the Army's new Inertial Guidance and Control Laboratory located at Redstone Arsenal, Alabama.

20. Army Missile Command, Huntsville, Alabama. DEGREE OF CLEANLINESS AND CLEAN-ROOM REQUIREMENTS, December 1962, 10p. MIL-STD-1246 (MI)

This document provides uniform criteria for minimum cleanliness and clean room requirements and serves as a guide in the selection of suitable cleaning agents and procedures for items of Military Materiel.

21. General Electric Company, Philadelphia, Pennsylvania. Missile and Space Vehicle Department. THE ROLE OF HUMAN FACTORS IN WHITE ROOM MANUFACTURING RELIABILITY, by Edward Gavurin. Seventh Mil-Ind Missile and Space Reliability Symposium, NAS, June 1962, 7p. N63-17276

The effect of selection, training, motivation and morale, and the special requirements for glove-handed operations upon the reliability of white room workers is discussed.

22. Minnesota University. School of Public Health. THE BACTERIOLOGY OF "CLEAN ROOMS", by G. S. Michaelsen. Progress Report, October 1, 1964 through March, 1965, 13p. NASA CR-63470 - N65-27296

Routine bacteriological ambient air, bench top surfaces, and stainless steel strip contamination sampling was carried out on eight occasions in each of four rooms representing different ranges of environmental control and personnel practices in regard to cleanliness.

23. National Aeronautics and Space Administration, Huntsville, Alabama. George C. Marshall Space Flight Center. DESIGN AND OPERATIONAL CRITERIA OF CONTROLLED ENVIRONMENT AREAS, STANDARD FOR. July 1963, 26p. MSFC-STD-246

This standard establishes criteria for use in determining design and functional requirements for controlled environment work areas. It is sued by all activities of the George C. Marshall Space Flight Center to meet and maintain cleanliness levels specified for space vehicle systems and associated equipment.

24. Sandia Corporation, Albuquerque, New Mexico. CONFERENCE ON CLEAN ROOM SPECIFICATIONS HELD AT SANDIA LABORATORY, ALBUQUERQUE, NEW MEXICO, APRIL 9-10, 1963, by B. A. Bice et al. May 1963, 103p. SCR-652 - N63-16287

The objectives of this conference were to develop a Federal Performance Standard for the construction, operation, and monitoring of clean room facilities.

25. Sandia Corporation, Albuquerque, New Mexico. DUST MONITORING IN CLEAN ROOMS. August 1961, 49p. Working Paper, SCIM 131-61(25)

The Advanced Manufacturing Development Division of the Sandia Corporation studied the overall clean room problem with particular emphasis placed on developing an adequate system for the detection, measurement, and control of air-borne dust in clean rooms. These papers were presented at the Clean Room Monitoring Seminar held on March 28 and March 31, 1961.

26. Sandia Corporation, Albuquerque, New Mexico. PRELIMINARY REPORT ON MICROBIOLOGICAL STUDIES IN A LAMINAR DOWN-FLOW CLEAN ROOM, by V. E. Arnold, A. J. Jack, J. G. King, R. C. Marsh, and W. J. Whitfield. January 1965, 27p. SC-RR-65-47 - N65-19646

Based on the results of experiments reported in this document, it can be stated conclusively that the laminar downflow clean room - using filtration and airflow control alone - can control airborne bacteria and fungi as successfully as it can airborne dust and droplets.

27. Society of Automotive Engineers, Incorporated. PROCEDURE FOR THE DETERMINATION OF PARTICULATE CONTAMINATION OF AIR IN DUST CONTROLLED SPACES BY THE PARTICLE COUNT METHOD. August 1962, 7p. Aerospace Recommended Practice, ARP 743.

A procedure given for self-checking the determination of particulate contaminant five microns or greater in size in air by the particle count method.

28. U. S. Department of Health, Education, and Welfare, Bethesda, Maryland. Public Health Service. DESIGN OF CLEAN ROOMS: A CLASSIFIED LIST OF SELECTED REFERENCES 1955-1964, compiled by Gertrude W. Fox. 1964, 11p. HEW Pub. Health Bib. Series No. 54.

Emphasis in compiling this list has been placed on biomedical applications. References were limited to those written in the English language. Entries have been made alphabetically by author under broad subject headings. Some brief annotations and an author index have been included.

29. U. S. Federal Supply Service, Washington, D. C. CLEAN ROOM AND WORK STATION REQUIREMENTS, CONTROLLED ENVIRONMENT. December 1963, 21p. Federal Standard No. 209.

Standard classes of environmental air control within clean rooms and work stations are established in this specification. The objective is to prescribe air cleanliness classes and other air environmental conditions required for achieving and maintaining the levels of cleanliness specified in the product specifications.

Books

1. Agnew, Boyd, LAMINAR/FLOW CLEAN ROOM HANDBOOK, Second Edition. Agnew-Higgins Publishing Company, Garden Grove, California, 1965, 77p.

   This handbook explains how laminar flow clean air handling equipment works and how to apply it to the various needs for a clean working environment. Chapters deal with design criteria and performance of blower-filter modules for laminar flow clean rooms, typical room and booth layouts using blower-filter modules, typical uses of laminar flow work stations, and questions and answers about laminar flow clean rooms.

2. Austin, Philip R. and Timmerman, Stewart, DESIGN AND OPERATION OF CLEAN ROOMS. Business News Publishing Company, Detroit, Michigan, 1965, 427p.

   Theoretical relationships governing airborne particulate matter, substantiated by experimental size-distribution data are presented in the first section of this book along with discussions of analysis of filtration, product requirements, and design of conventional and second-generation clean rooms. The second section discusses the operation of clean rooms and clean work stations, along with the particular subjects of monitoring, garmenting, cleaning of parts, and clean room specifications.